

TWO NEW SPECIES OF *ELYMUS* (POACEAE) IN THE SOUTHERN U.S.A. AND OTHER NOTES ON NORTH AMERICAN *ELYMUS* SPECIES

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ABSTRACT

Two new species of *Elymus* L. are described, **E. churchii** J.J.N. Campb. and **E. texensis** J.J.N. Campb. *Elymus churchii* grows in the Ouachita and Ozark Mountains of Arkansas, Missouri and Oklahoma. It is similar to *E. svensonii* G.L. Church, but differs in its lemmas, which are usually pubescent, and have longer awns; its spikelets, which have fewer florets; its rachis internodes, which are longer, with hispid dorsal ridges and green longitudinal bands; and its foliage, which is typically less pubescent and less glaucous. *Elymus texensis* grows on the Edwards Plateau in southwest Texas. It is similar to *E. pringlei* Scribn. & Merr., but differs in its larger anthers; its glabrous lemmas; its larger spikelets; its longer spikes, with rachis internodes that are longer, with green longitudinal bands, and generally glabrous; and its foliage, which is sometimes densely pilose. The new species are known from few collections, and need much more study to assess their phylogentic status and geographic distribution. They are published here to allow inclusion in the Flora of North America, volume 24, and to stimulate further attention to them. Some additional notes and corrections are appended regarding the author's previous publications on *Elymus*.

RESUMEN

Se describen dos nuevas especies de *Elymus* L., **E. churchii** J.J.N. Campb. y **E. texensis** J.J.N. Campb. *Elymus churchii* vive en las montañas Ouachita y Ozark de Arkansas, Missouri y Oklahoma. Es similar a *E. svensonii* G.L. Church, pero se diferencia por sus lemas, que son usualmente pubescentes, y tienen aristas más largas; sus espiguillas, que tienen menos flores; sus internudos del raquis, que son más largos, con costillas dorsales híspidas y bandas verdes longitudinales; y su follaje, que es típicamente menos pubescente y menos glauco. *Elymus texensis* vive en el Edwards Plateau en el sureste de Texas. Es similar a *E. pringlei* Scribn. & Merr., pero difiere por sus anteras más grandes; sus lemas glabros; sus espiguillas más grandes; sus espigas más largas, con internados del caquis que son más largos, con bandas verdes longitudinales, y generalmente glabras; y su follaje, que es a veces densamente piloso. Las nuevas especies se conocen de pocas colecciones, y necesitan mucho más estudio para evaluar su estatus filogenético y distribución geográfica. Se publican aquí para que puedan incluirse en la Flora de Norte América, volumen 24, y para estimular la atención sobre ellas. Se añaden notas adicionales y correcciones a publicaciones previas del autor sobre *Elymus*.

INTRODUCTION

In 2002, I provided descriptions, specimen data, and distribution maps for two taxa of *Elymus* that seemed different from other members of the genus with paired spikelets and reduced or vestigial glumes (Campbell 2002a). I refrained

then from formal taxonomic recognition, but after further revision I am now more confident. To allow inclusion in the Flora of North America, volume 24 (M.E. Barkworth et al., in prep.), I present below the two new names, and a key to the species of *Elymus* that have paired spikelets and reduced or vestigial glumes. There has been much uncertainty in the circumscription and phylogeny of these species, which would have been grouped together under the broad concept of *Elymus interruptus* Buckley by Hitchcock and Chase (1951).

Elymus churchii J.J.N. Camp., sp. nov. (**Fig. 1**). TYPE: U.S.A. ARKANSAS: Conway Co.: Petit Jean State Park, rocky bluffs, P.O. Morrilton, 1500 ft, 3 Jul 1957, D. Demaree 37234 (HOLOTYPE: UARK; ISOTYPES: OKL, SMU-BRIT).

Affine *Elymo svensonii* G.L. Church sed differt lemmibus plerumque pubescentibus aristis (10–)20–30(–35) mm longis, spiculis flosculis 3(–5), internodis spicarum (5–)7–13(–18) mm longis viridi-vittatis dorsaliter hispidis, foliis paginis adaxialibus glabris vel pilosis, et plantis non glaucissimis.

Plants caespitose, often somewhat, but not strongly, glaucous. **Culms** 50–120 cm, erect; **nodes** usually 4–8, exposed or covered, often reddish-brown or blackish, glabrous. **Leaves** evenly distributed; **sheaths** usually glabrous, or sometimes pubescent at the summit; **auricles** 1–2 mm, often reddish brown or blackish; **ligules** up to 1 mm, often reddish-brown; **blades** 3–11 mm wide, lax, adaxial surfaces glabrous or short-pilose. **Spikes** 10–18 cm long, 3–5 cm wide, slightly nodding, with 2 spikelets per node; **internodes** (5–)7–13(–18) mm, about 0.2 mm thick at the thinnest sections, flexuous, with green longitudinal bands along the concave sides, glabrous except for the two hispid dorsal ridges; **disarticulation** below each floret, but not below the glumes. **Spikelets** usually appressed, 10–15 mm (excluding awns), with 3(–5) florets. **Glumes** often unequal (differing in length by more than 5 mm), or sometimes vestigial to absent from the upper spikelets or throughout, 0–15(–20) mm long including the undifferentiated awns, indurate at base, 0.1–0.3 mm wide, setaceous to subulate, with 0–1 distinct vein, glabrous, awns often outcurving; **lemmas** 8–10 mm, pubescent, or occasionally glabrous, awns (10–)20–30(–35) mm, slightly to (at maturity) strongly outcurving; **paleas** 7–9 mm, obtuse to truncate, or emarginate; **anthers** about 2.5–3 mm, evident in June. $2n$ = unknown.

Elymus churchii grows in dry rocky soils, often base-rich, in open woods on ridges, bluffs and river banks of the central Ouachita Mountains and the western Ozark Mountains, in Arkansas, Oklahoma and Missouri. It was previously included within a broad concept of *E. interruptus* (Steyermark 1963; Smith 1991). It is similar to *E. svensonii*, which is disjunct in Kentucky and Tennessee. It might reasonably be combined as a subspecies or variety of *E. svensonii*, but differs in its lemmas, which are usually pubescent, and have longer awns; its spikelets, which have fewer florets; its rachis internodes, which are longer, with hispid dorsal ridges and green longitudinal bands; and its foliage, which is typically less pubescent and less glaucous. It may have originated, like *E. svensonii*,

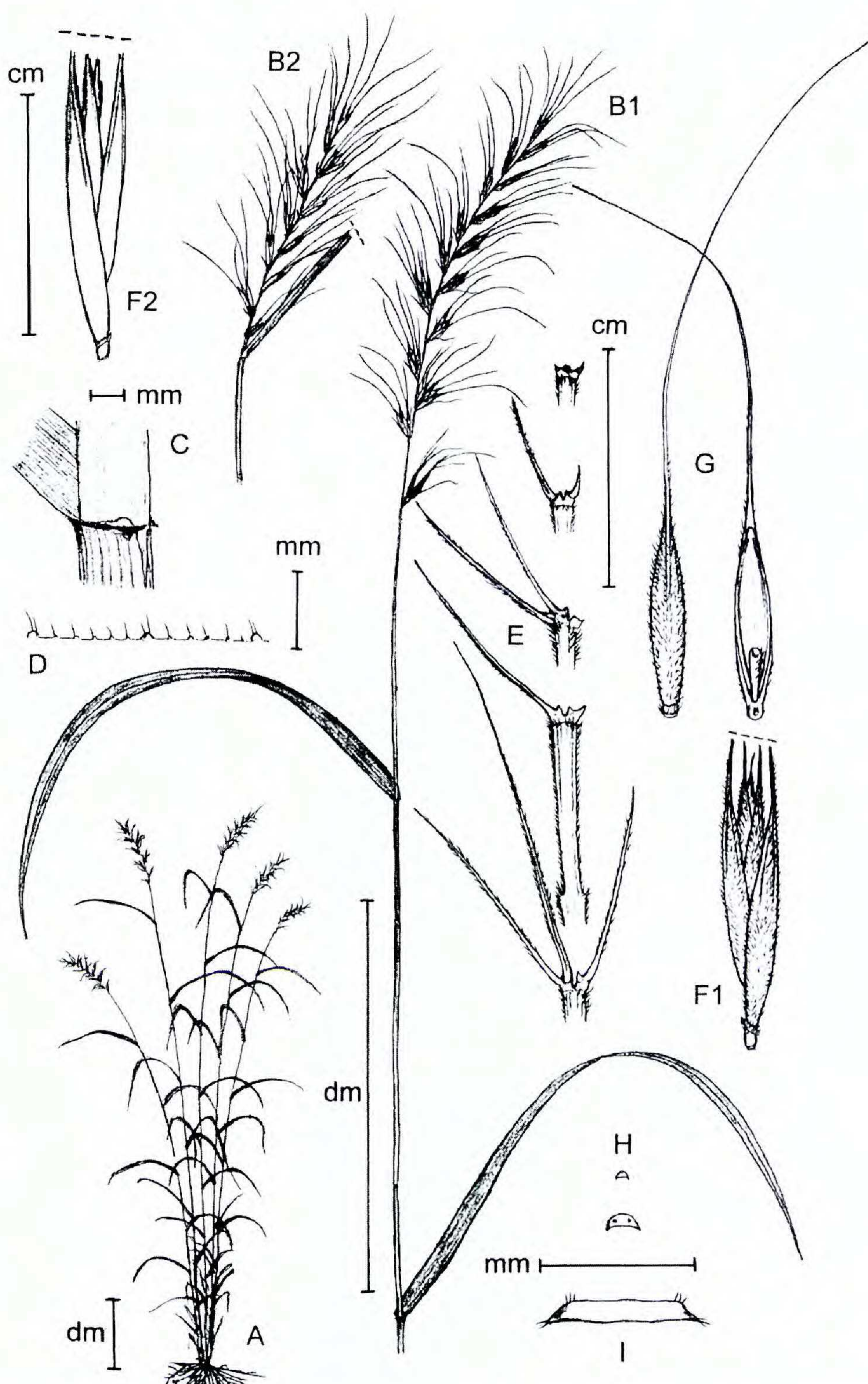


FIG. 1. *Elymus churchii* (drawn from *Demaree* 29337 unless noted). **A.** Habit. **B.** Upper portion of culm with mature spike, viewed on plane with alternating spread of spikelets (B2 from *Palmer* 57957). **C.** Sheath summit and blade bases. **D.** Adaxial leaf surface, showing veins and hairs. **E.** Mature rachis internodes and glumes (showing variation in size), viewed in plane of spikelet spread (with abaxial view of central glume in spikelet, and largely side view of lateral glume). **F.** Spikelet, with lateral view of florets (F2 from *Palmer* 57957). **G.** Mature floret in abaxial view (left) and adaxial view (right). **H.** Cross-sections of mature, indurate glume bases (showing variation in size). **I.** Cross-section of central rachis internode.

from introgression of *E. canadensis* L. and *E. hystrix* L., and there are occasional specimens suggesting transitions to both species (Campbell 2002a). This species is named after George L. Church, who conducted several useful studies of *Elymus* in eastern North America, focusing on problems of hybridization and the species with reduced glumes (Church 1967).

PARATYPES: **ARKANSAS. Baxter Co.:** rocky shaded bluff, White Rv., P.O. Lakeview, Bull Shoals Dam Reservoir, 600 ft, 1 Jul 1950, *D. Demaree* 29337 (OKL, TEX). **Logan Co.:** Magazine Mt., about 45 mi east of Fort Smith, 8 Aug 1942, *D.M. Moore* 420118 (TEX), Sep 1947, *D.M. Moore* 470639/642 (UARK, NCU, US), and 30/31 Jul 1949, *D.M. Moore* 490422/441 (UARK). **Newton Co.:** Big Bluff above Buffalo Rv., 5 mi below Ponca, 5 Jun 1953, *D.M. Moore* 53259 (UARK). **OKLAHOMA. Le Flore Co.:** Rich Mt., roadside, oak-pine dominant, 16 Jun 1940, *H. Taylor* 110 (OKL); see also Campbell (2002a).

The only collection known from Missouri has relatively short rachis internodes (ca. 5–7 mm): Christian Co., 3 miles west of Nixa, rocky wooded banks, 24 Jun 1954, *E.J. Palmer* 57957 (SMU). I previously suspected that all of Steyermark's (1963) records of *Elymus diversiglumis* Scribn. & C.R. Ball or *E. interruptus* in Missouri could be grouped with the plants described here as *E. churchii* (Campbell 2002a). However, some of these records were based on misidentifications: *E.J. Palmer* 66416 (UMO) is *E. glabriflorus* var. *australis* (Scribn. & C.R. Ball) J.J.N. Campb.; *E.J. Palmer* 55939 (UMO) is *E. hystrix* var. *bigelovianus* (Fernald) Bowden.

Elymus texensis J.J.N. Camp., sp. nov. (**Figs. 2a, b**). TYPE: U.S.A. TEXAS. Gillespie Co.: Serpentine Mounds, about 9 mi N of Willow City, hilly area vegetated mainly with grasses, 18 May 1966, *E.S. Nixon* 531 (HOLOTYPE: TEX 5322).

Affine *Elymo pringlei* Scribn. & Merr. sed differt antheris 4.5–6 mm longis, lemmibus glabris, spiculis 25–40 mm longis flosculis 5–8, spicis 9–20 cm longis internodis (5–)7–15(–22) mm longis viridivittatis glabris praeter margines ciliolatos, foliis paginis adaxialibus dilute scabri-hirsutis vel dense brevipilosis.

Plants caespitose, glaucous. **Culms** 70–110 cm, erect; **nodes** usually 4–6, mostly exposed, glabrous. **Leaves** evenly distributed; **sheaths** glabrous; **auricles** about 0–1 mm, sometimes adherent to sheath summit, pale to purplish brown; **ligules** about 1 mm, erose; **blades** 2–9 mm wide, lax, or somewhat involute, adaxial surfaces thinly scabrous-hirsute or densely short-pilose. **Spikes** 9–20 cm long, 2–2.5 cm wide, erect to slightly nodding, with 2 spikelets per node; **internodes** (5–)7–15(–22) mm, about 0.1–0.3 mm thick at the thinnest sections, with slight dorsal ridges, with green longitudinal bands along the concave sides, glabrous except for the ciliate margins; **disarticulation** below each floret, but not below the glumes. **Spikelets** appressed, 25–40 mm (excluding awns), with 5–8 florets (including terminal rudiment). **Glumes** subequal, 14–24 mm long including the undifferentiated awns, 0.1–0.3 mm wide, setaceous, with 0–1 distinct vein, glabrous, awns more or less straight; **lemmas** 8–12 mm, glabrous, awns 8–25 mm, straight, flexuous or slightly curving; **paleas** about 7–11 mm, obtuse or narrowly truncate; **anthers** 4.5–6 mm, evident in May. $2n$ = unknown.

Elymus texensis is known only from three collections that were made on calcareous bluffs and hills, in juniper woods and grassy areas on the Edwards Plateau of southwest Texas (Campbell 2002). It is similar to *E. pringlei*, but differs in its larger anthers; its glabrous lemmas; its larger spikelets; its longer spikes, with rachis internodes that are longer, with green longitudinal bands, and generally glabrous; and its foliage, which is sometimes densely pilose. It is notable that the northernmost known collection of *E. pringlei* appears somewhat atypical and may be transitional to *E. interruptus* or *E. texensis*: MEXICO, Coahuila, 54 mi SE of Big Bend National Park, south end of Sierra Maderas del Carmen, Canyon de la Fronteriza, rhyolite area, J. Henrickson 15045 (TEX). That collection has relatively robust glumes, long rachis internodes, spikelets with up to 6 florets (including the terminal rudiment), and lemmas that are virtually glabrous (Campbell 2002a). This new species is named after the great state of Texas.

PARATYPES: **TEXAS. Burnet Co.:** Inks Lake State Park, limestone bluffs, juniper woods along creek just east of HQ, 19 May 1983, R. & G. Kral 70066 (VDB, SMU-BRIT). **Uvalde Co.:** chalk bluff on Nueces River, 12 May 1938, V.L. Cory 29073 (US 3039432).

KEY TO *ELYMUS HYSTRIX* AND ITS ALLIES

These two new species appear to belong in a natural group with *Elymus hystrix* and other allies. The following key distinguishes the members of this group. Brief notes on ranges are inserted, but Campbell (2002a) should be consulted for maps and further details.

This group of species is characterized by their reduced or vestigial glumes, with 0–1(–2) veins, tapering from the base, 0–24 mm long including awns, often differing in length by at least 4 mm, 0.1–0.5(–0.7) mm wide, persistent after florets disarticulate; and by their rachis internodes usually 0.1–0.3 mm thick at the thinnest sections, often with green longitudinal bands along the concave sides. This group should be contrasted with the more heterogeneous group that consists of *E. virginicus* L., *E. canadensis* L., *E. glaucus* Buckley and their allies. The latter species have glumes with 2–5(–8) veins, widening or linear above the base, 4–45 mm long including awns, subequal, 0.2–2.3 mm wide, persistent or disarticulating; and rachis internodes usually 0.2–0.8 mm thick at the thinnest sections, usually lacking green bands. *Elymus interruptus* remains a somewhat problematic taxon, with specimens that can fit within either of these outlines. Moreover, various hybrids of *E. hystrix* with other species will fit within either outline, and will require deeper analysis. It is likely that some allies of *E. hystrix* in this group originated from hybridization (Church 1967; Campbell 2002a).

1. Spikelets widely divergent to perpendicular at maturity; lemma awns straight (rarely slightly curving); glumes vestigial or 1–3 mm long, occasionally some unequal glumes up to 10(–20) mm long and 0.1–0.2 mm wide but with no distinct vein; spikes more or less erect [widespread in eastern North America, but unknown in Texas] _____ ***E. hystrix***

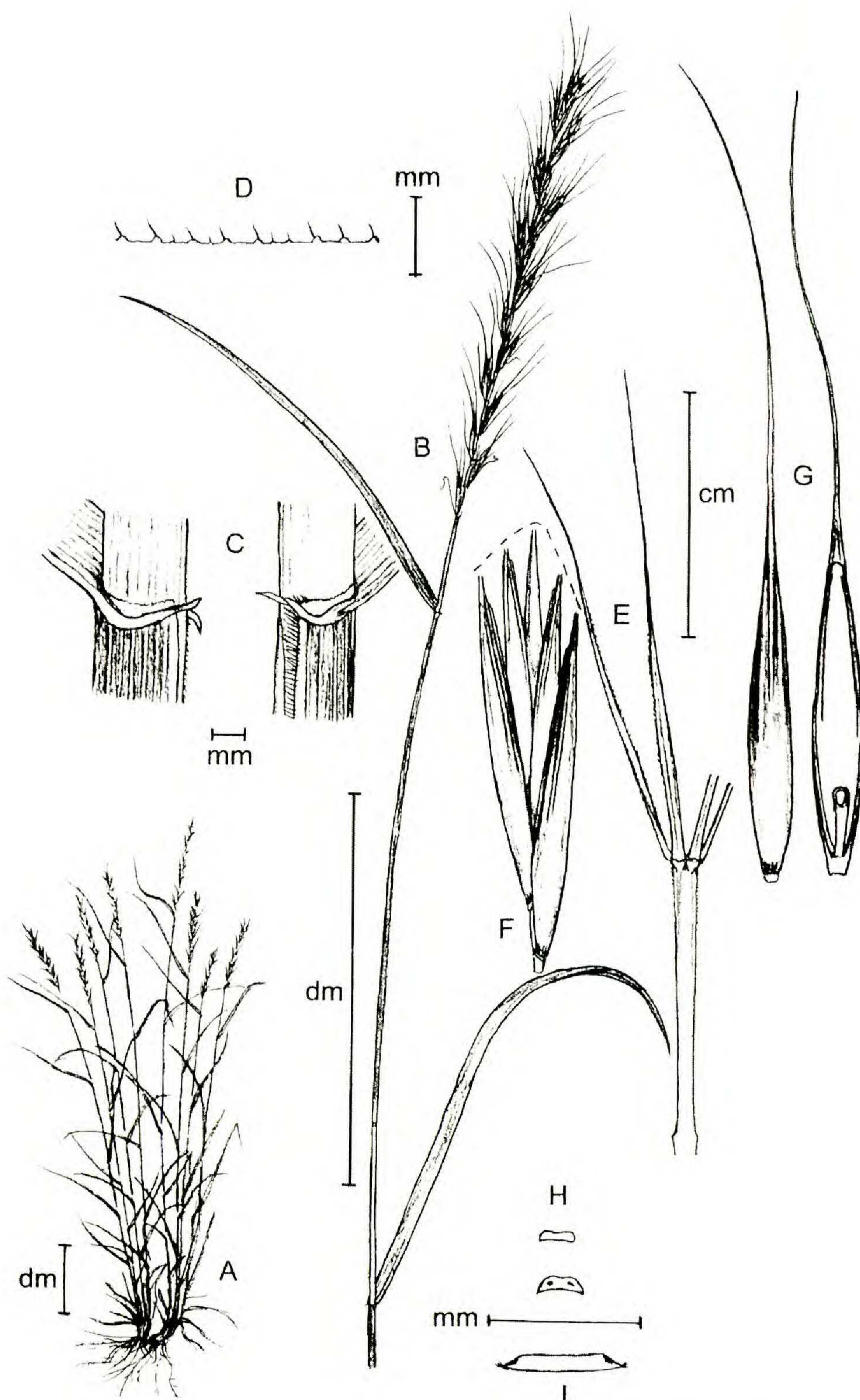


FIG. 2a. *Elymus texensis* (2a drawn from E.S. Nixon 531). **A.** Habit. **B.** Upper portion of culm with mature spike, viewed on plane with alternating spread of spikelets. **C.** Sheath summit and blade base. **D.** Adaxial leaf surface, showing veins and hairs. **E.** Mature rachis internode and glumes, viewed in plane of spikelet spread (with abaxial view of central glume in spikelet, and largely side view of lateral glume). **F.** Spikelet, with lateral view of florets. **G.** Mature floret in abaxial view (left) and adaxial view (right). **H.** Cross-sections of mature, indurate glume base(s). **I.** Cross-section of central rachis internode.

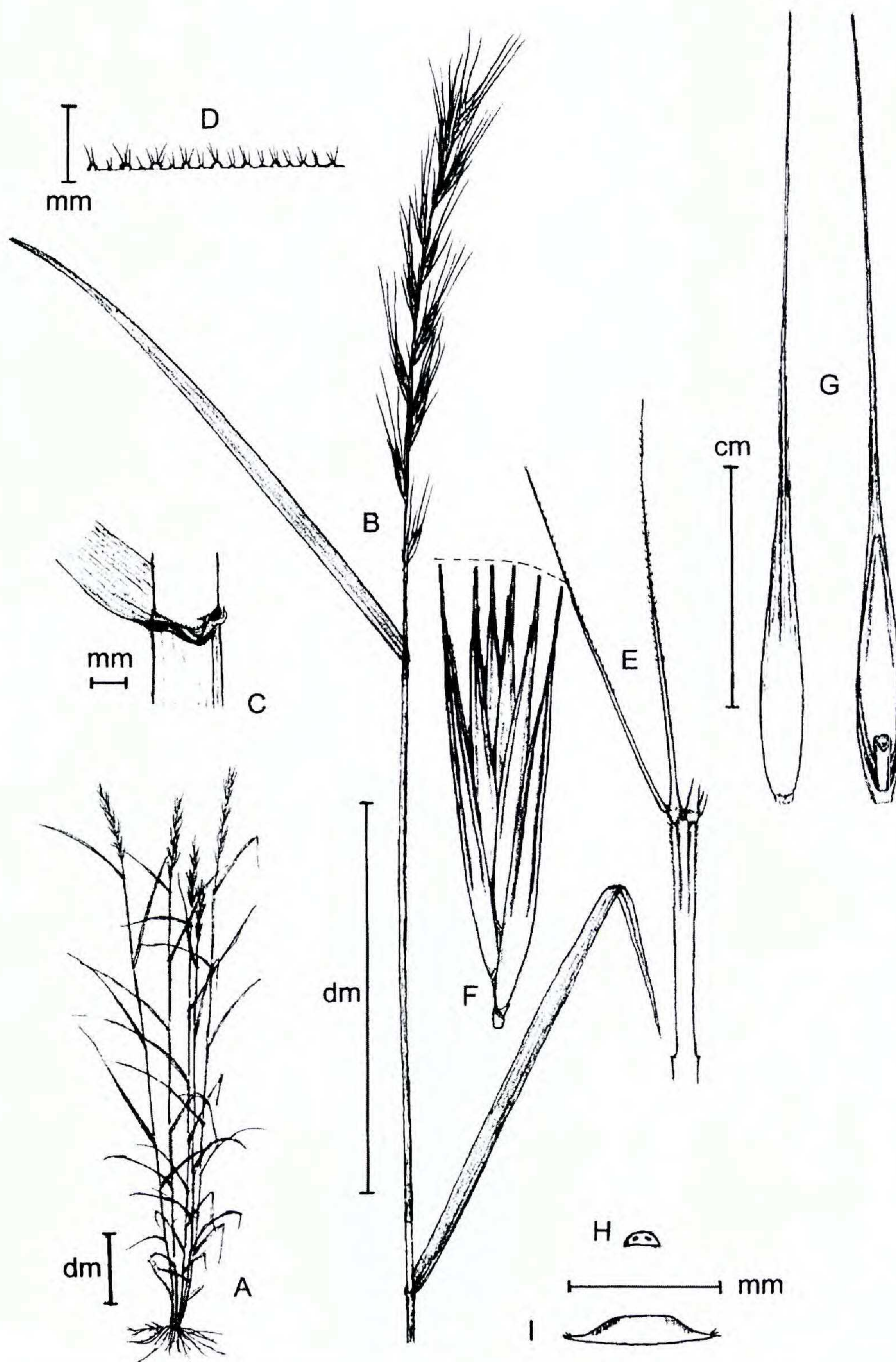


FIG. 2b. *Elymus texensis* (2b drawn from V.L. Cory 29073). **A.** Habit. **B.** Upper portion of culm with mature spike, viewed on plane with alternating spread of spikelets. **C.** Sheath summit and blade base. **D.** Adaxial leaf surface, showing veins and hairs. **E.** Mature rachis internode and glumes, viewed in plane of spikelet spread (with abaxial view of central glume in spikelet, and largely side view of lateral glume). **F.** Spikelet, with lateral view of florets. **G.** Mature floret in abaxial view (left) and adaxial view (right). **H.** Cross-sections of mature, indurate glume base(s). **I.** Cross-section of central rachis internode.

1. Spikelets usually appressed, never perpendicular; lemma awns straight or curving; glumes sometimes vestigial, but usually 1–24 mm long, 0.1–0.5(–0.7) mm wide, often with a distinct vein; spikes erect, nodding or pendent.
2. All glumes well-developed, at least 12 mm long, subequal; lemma awns straight to moderately curving; spikes erect to slightly nodding.
3. Spikelets (6–)9–15(–22) mm long (excluding awns), each with 2–5 florets; lemma awns moderately outcurving at maturity; glumes 0.2–0.5(–0.7) mm wide [in the southern Rocky Mountains and adjacent regions, from southern California to western Texas to northern Coahuila] _____ **E. interruptus**
3. Spikelets 18–40 mm long (excluding awns), each with 3–8 florets; lemma awns straight to slightly curving at maturity; glumes 0.1–0.3(–0.6) mm wide.
4. Anthers 2.5–4 mm long; lemmas scabrous-hispid to thinly strigose-pubescent; spikelets 18–25 mm long, with 3–6 florets; spikes 4–12 cm long, rachis internodes 3–6 mm long, without green longitudinal bands, hispid on dorsal ridges; blades thinly scabridulous, hispidulous or pilose on veins [along the Sierra Madre Orientale, in eastern Mexico from Coahuila to Veracruz] _____ **E. pringlei**
4. Anthers 4.5–6 mm long; lemmas glabrous; spikelets 25–40 mm long, with 5–8 florets; spikes 9–20 cm long, rachis internodes (5–)7–15(–22) mm long, with green longitudinal bands, glabrous except for ciliolate margins; blades thinly scabrous-hirsute to densely pilose [on the Edwards Plateau, in south west Texas] _____ **E. texensis**
2. Some glumes less than 12 mm, each pair usually differing in length by at least 4 mm when developed, or one or both vestigial; lemma awns outcurving at maturity, often strongly so; spikes slightly nodding to pendent.
5. Rachis internodes 4–6(–9) mm long; glumes (0.1–)0.2–0.5(–0.6) mm wide; lemmas hirsute to strigose, at least near margins; sheaths glabrous; plants not glaucous to moderately glaucous [mostly in the northern Great Plains, from Saskatchewan to Ontario to Iowa] _____ **E. diversiglumis**
5. Rachis internodes (4–)6–13(–18) mm long; glumes 0.1–0.3 mm wide; lemmas glabrous or pubescent; sheaths glabrous or villous; plants usually glaucous, sometimes strongly so.
6. Lemmas usually pubescent, the awns (10–)20–30(–35) mm long; spikelets with 3(5) florets; rachis internodes (5–)7–13(–18) mm long, with green longitudinal bands and hispid dorsal ridges; blades glabrous or short-pilose; plants not strongly glaucous [central Ouachita and western Ozark mountains, in Arkansas, Missouri and Oklahoma] _____ **E. churchii**
6. Lemmas glabrous, or occasionally hispidulous near apex, the awns (8–)10–20(–25) mm long; spikelets with (3–)4–5 florets; rachis internodes (4–)6–10(–12) mm long, without green longitudinal bands, glabrous; blades usually villous; plants strongly glaucous [central Interior Low Plateaus, in Kentucky and Tennessee] _____ **E. svensonii**

OTHER NOTES

The taxonomy of *Elymus* in North America has a long tortuous history. In drafting a treatment of the species with paired spikelets, I have made some suggestions for nomenclature, which will hopefully guide botanists in their interpretation of these taxa (Campbell 1995, 1996, 2000, 2002a, 2002b, 2002c). However, it is clear that much deeper analysis is needed, including a proper focus at the

genetic level, instead of relying just on the rather inadequate morphological differences. There has been much taxonomic confusion, misidentification, and erroneous reporting of distributions. Many mysteries remain.

An *Elymus hystrix*-like collection from New Mexico

An anomalous collection that may have similarities to both *Elymus hystrix* and *E. interruptus* is of interest here: NEW MEXICO [Colfax Co.], Cimarron, wooded bank, 6 Jul 1939, W.A. Silveus 4928 (TEX). This specimen was listed by Church (1967) under his "atypical" *E. hystrix* group with filiform glumes. Unfortunately all the florets are lost, but the glumes are narrower (ca. 0.2 mm) and more widely spreading than typical *E. interruptus*, and rachis internodes are shorter (ca. 5 mm). This specimen suggests that plants closely related to *E. hystrix* may still be found in northern New Mexico or nearby. The closest documented *E. hystrix* is in eastern Oklahoma. Does this New Mexico plant have a distinct origin, perhaps from some isolated introgressed population?

***Elymus interruptus* in California**

I recently discovered the following specimen of *Elymus interruptus*: CALIFORNIA, Fresno Co., Pine Ridge, altitude 5300 ft, "Plants of the Sierra Nevada Mountains," 15-25 Jul 1900, H.M. Hall & H.P. Chandler 317 (DOV). This collection was initially annotated as *E. canadensis*. It appears to be the first record of *E. interruptus* from California. The few other records of *E. canadensis* from the state should be checked.

Need to clarify typification of *Elymus virginicus*

Some of the Linnaean material of *Elymus virginicus* does not clearly match our current typical concept of that species, and should probably be included with *E. glabriflorus* (Vasey ex L.H. Dewey) Scribn. & C.R. Ball. I proposed to the International Association for Plant Taxonomy that the name *E. virginicus* be retained for the typical plants of Hitchcock and Chase (1951) and most other authors, with a new type established for that species (Campbell 1996). However, more careful analysis of the several sheets of Linnaean material is needed, and the Nomenclature Committee remains undecided (D. Nicholson & R. Soreng, pers. comm.). After the treatment in *Flora of North America* is published, there will undoubtedly be further consideration of this problem, and I hope to revive the proposal with more evidence.

Corrections to Campbell (2002b)

- (a) In the key, leads (number 13 & 14) to *E. glaucus*, *E. hirsutus* J. Presl. and *E. dahuricus* Turcz. ex Griseb. will be modified substantially for the *Flora of North America*. *E. dahuricus* is a rare Asian introduction that appears close to *E. hirsutus*; its lemmas can be glabrous, not just scabrous or hispid, as stated in the key.
- (b) In the key, the lead (number 15) to *E. interruptus* versus *E. canadensis* and *E. wiegandii* Fernald should omit the spike internode thickness character, which reflected some erroneous data.

(c) By priority, the correct name for *Elymus submuticus* (Hook.) Smyth & Smyth is *E. curvatus* Piper.

ACKNOWLEDGMENTS

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